PATENT SPECIFICATION

762,906

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COMPLETE SPECIFICATION.

Improvements in or relating to Composite Articles including Porous Members.

We, THE BIRMINGHAM SMALL ARMS COMPANY LIMITED, a British Company, of Small Heath Works, Birmingham 11, do hereby declare the invention for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement :—

This invention relates to composite articles including porous members, and has particular, though not exclusive, reference to composite articles such as filters including one or more porous plates produced by powder metallurgy.

Powder metallurgy members are capable of being attached to other metallic members by welding or brazing (the selection of the method employed having to take into account the nature of the material of the other members), but the high temperatures necessary make these methods difficult of application in many instances and may even endanger the powder metallurgy member by the risk of cracking, undesired oxidation, and closing of pores near the union. A case in point is the fitting of a powder metallurgy filter plate in a funnel filter : whatever the metals used in the plate and the funnel body, the welding of the plate to the body is difficult and costly to accomplish ; if corrosion-resistant metals, such as stainless steel, are used, the difficulty and expense are increased. Particular care must be exercised to ensure that the weld itself does not contain pores that would permit passage of particles of a size that the plate is designed to retain.

According to the present invention, a composite article comprises a porous metallic member and a thermoplastic member, the two members being secured to each other by diffusion of the material of the thermoplastic member into the pores of the part of the other member contiguous to the thermoplastic member. The pores of the porous member provide for such penetration of the thermoplastic material from the one member into the other that the junction does not depend upon mere surface adhesion ; instead, the joint is closely comparable in strength to the strength of the thermoplastic material itself.

The invention also includes a method of forming a composite article, the method comprising the application of a porous metallic member to a thermoplastic member under heat and pressure sufficient to cause heat-softened material of the part of the thermoplastic member contiguous to the other member to diffuse into the pores of the other member, and allowing the softened material to set by cooling. The heat and pressure produce viscous flow of thermoplastic material contiguous to the surface of the porous metallic member, so that there is penetration by capillarity into the pores. On setting, the thermoplastic material that has thus diffused into the pores merges uniformly into the body of the thermoplastic member itself, with the advantage as to the strength of the joint already mentioned.

By interposing the thermoplastic member between two porous metallic members, those two members may be secured together by diffusion of the thermoplastic material into their pores and subsequent setting of the thermoplastic material.

The thermoplastic member may be a major member of the composite article, for instance the body of a funnel filter to receive a porous filter plate formed by powder metallurgy, or a tube to contain a similar filter plate. It may, however, be mainly a connector between two powder metallurgy members, operating

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but consists in diffusion of the thermoplastic material into the porous plate.

In Figure 6, a filter plate 18 is embedded in a thermoplastic plate 19 by forming a hole 20 in the latter slightly smaller than the filter plate 18 and pressing the members together after preliminary heating, until peripheral adhesion is effected, with one face 21 of the filter plate 18 flush with one face 22 of the thermoplastic plate 19. By embedding a number of filter plates in a large thermoplastic plate in this manner, a filter surface may be formed of dimension greater than possible in a single powder metallurgy filter plate. The individual plate or plates 19 may be of any desired shape, e.g., square or round, with the smaller hole or holes 20 of appropriately similar shape.

Two or more filter plates may be assembled into a larger plate by interposing heated thermoplastic material 23 (Figure 7) between adjacent edges 24, 25 of the heated plates 26, 27 and applying pressure to force the edges towards each other. The interposed material may be a strip of width little greater than the thickness of the plates, or, as shown in Figure 8, a strip 28 of greater width may be used to join two porous plates 29, 30 together, which strip 28 acts as beam reinforcement of the filter plate assembly under the load applied by pressure or vacuum.

In Figure 9, a thin strip 31 of thermoplastic material is hot-pressed between one edge 32 of a porous plate 33 and one surface 34 of another porous plate 35, thus joining the plates 33, 35 together at right angles by diffusion of the thermoplastic material into the pores of both plates 33, 35. The flash 36 of thermoplastic material forms a fillet between the two plates, which may be allowed to remain.

Similar interposition of thermoplastic strips or sheets between porous plates may be used to build up more or less elaborate assemblies, consisting either mainly of the porous sheets with the interposed material acting principally as jointing, or of a number of walls partly porous and partly non-porous, the thermoplastic material of the material of the latter securing the walls together by diffusion.

Two such assemblies are shown in Figures 10 and 11. Figure 10 shows an aerator, consisting of a porous filter plate 37 embedded in one end 38 of a short length of thermoplastic tube 39 of large diameter, the other end 40 of the tube 39 being closed by a thermoplastic plate 41 heat-welded to the tube 39 around the periphery at 42, with a hole 43 in the plate 41 registering with the bore 44 of a thermoplastic tube 45 heat-welded to the plate 41 at 46.

In Figure 11, a box filter 47 is heat-welded at 48 to the end 49 of a thermoplastic tube 50 and consists of four walls 51 and a bottom 52 of thermoplastic material into which are embedded five square filter plates 53. A top 54 of thermoplastic material has a hole 55 registering with the bore 56 of the tube 50, and the walls 51, the bottom 52, and the top 54 are joined together by heat-welding along the adjacent edges as shown at 57.

Where the edge of a thermoplastic sheet makes sealing contact with a porous plate, the thermoplastic material may be spread into a flange to increase the area of contact. Such flanges, or the mere flash produced as previously indicated, may be subsequently subjected to heat under pressure to bring about a diffusion of thermoplastic material into an area of the porous plate substantially greater than that covered by the thickness of the thermoplastic sheet.

What we claim is:—

1. A method of forming a composite article, comprising the application of a porous metallic member to a thermoplastic member under heat and pressure sufficient to cause heat-softened material of the part of the thermoplastic member contiguous to the other member to diffuse into the pores of the other member, and allowing the softened material to set by cooling.

2. A method as in Claim 1, wherein the thermoplastic member is interposed between two porous metallic members, so that by diffusion of the thermoplastic material into the pores of the metallic members and subsequent setting of the thermoplastic material the metallic members are secured together.

3. A method as in Claim 1 or Claim 2, wherein both the porous metallic member and the thermoplastic member to be secured to each other are heated.

4. Methods of forming composite articles from porous metallic members and thermoplastic members substantially as hereinbefore described.

5. A composite article comprising a porous metallic member and a thermoplastic member, the two members being secured to each other by diffusion of the material of the thermoplastic member into the pores of the part of the other member contiguous to the thermoplastic member.

6. A composite article as in Claim 5, wherein the thermoplastic member comprises a major member of the article.

7. A composite article as in Claim 6, comprising a funnel filter body or tube of thermoplastic material and a porous filter plate formed by powder metallurgy secured in the body by diffusion of the thermoplastic material into the pores of the filter plate.

8. A composite article comprising two powder metallurgy members secured together by a connector of thermoplastic material between them, with the material of the connector diffused into the pores of the parts of the members contiguous to the connector.

9. A composite article as in Claim 8, comprising an assembly of porous metallic sheets with interposed thermoplastic material acting principally as jointing.

10. A composite article as in Claim 8, comprising an assembly of walls partly porous and partly non-porous, the thermoplastic material of the latter securing the walls together by diffusion.

11. Composite articles substantially as hereinbefore described with reference to the accompanying drawings.

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PROVISIONAL SPECIFICATION.

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Powder metallurgy members are capable of being attached to other metallic members by welding or brazing (the selection of the method employed having to take into account the nature of the material of the other members), but the high temperatures necessary make these methods difficult of application in many instances and may even endanger the powder metallurgy member by the risk of cracking, undesired oxidation, and closing of pores near the union. A case in point is the fitting of a powder metallurgy filter plate in a funnel filter : whatever the metals used in the plate and the funnel body, the welding of the plate to the body is difficult and costly to accomplish ; if corrosion-resistant metals, such as stainless steel, are used, the difficulty and expense are increased. Particular care must be exercised to ensure that the weld itself does not contain pores that would permit passage of particles of a size that the plate is designed to retain.

According to the present invention, a composite article comprises a porous metallic member and a thermoplastic member, the two members being secured to each other by diffusion of the material of the thermoplastic member into the pores of the part of the other member contiguous to the thermoplastic member.

The invention also includes a method of forming a composite article, the method comprising the application of a porous metallic member to a thermoplastic member under heat and pressure sufficient to cause heat-softened material of the part of the thermoplastic member contiguous to the other member to diffuse into the pores of the other member, and allowing the softened material to set by cooling.

The thermoplastic member may be a major member of the composite article, for instance the body of a funnel filter to receive a porous filter plate formed by powder metallurgy, or a tube to contain a similar filter plate. It may, however, be mainly a connector between two powder metallurgy members, operating by diffusion into the pores of both such members.

The diffusion of the thermoplastic material into the pores produces a joint closely comparable in strength to the strength of the thermoplastic material itself. Where, as in the case of a filter, the attachment of the filter plate to the body must be free from pores, this result is automatically achieved by the adhesion effected thermoplastically.

The heating of the thermoplastic component may in many cases be effected by the usual hot plate, to which the component is applied for a suitable time before being applied under pressure to the porous component—which also may be preliminarily heated, by a hot plate or otherwise. Induction heating or welding may also be used where convenient.

Thermoplastic materials generally may be used for the one component of the article, the choice depending on the properties required in the final article, e.g. as regards resistance to acids, alkalis, oils, or other material to be handled, or temperature or other physical condition encountered in use. Examples of suitable materials are polythene (polyethylene), polystyrene, polyvinylchloride, polytetrafluoroethylene, nylon, and cellulose acetate and other esters or mixed esters of cellulose.

The invention has numerous applications, of which the following are examples :—

A funnel filter is formed from two separate parts of thermoplastic material, a funnel and spout, which may be a one-piece moulding,

and a tube of diameter equal to that of the open end of the funnel. A porous filter plate of diameter rather greater than the inside of the tube is heated on a hot plate, and one end of the tube, which end has also been heated on a hot plate, is applied with pressure concentrically to the filter plate so that the latter is pressed into the end of the tube. The funnel mouth, similarly heated, is then applied to the opposite side of the filter plate and welds itself to both the end of the tube and the filter plate. The plate is thus welded into the complete funnel formed by the autogenous union of the funnel and spout with the tube. Any slight flash spreading round the surfaces of the plate may be allowed to remain.

A similar procedure may be followed to weld a filter plate in a run of pipe by hot-pressing the ends of two thermoplastic tubes on to a plate of a diameter slightly greater than the bore of the tubes; or the end of a single tube may be similarly closed by a filter plate.

Again, the end of a tube may be hot-pressed on to a filter plate of a size exceeding the diameter of the tube, the tube being caused to flow externally into a flange that increases the annular area of contact with the plate.

A filter plate (or a number of plates) may also be embedded in a thermoplastic plate by forming a hole (or a number of holes) in the latter slightly smaller than the filter plate or plates and pressing the members together after preliminary heating, until peripheral adhesion is effected, generally with at least one face of a filter plate flush with a face of the thermoplastic plate. In this way, a filter surface may be formed of dimensions greater than possible in a single powder metallurgy filter plate.

Again, two or more filter plates may be assembled into a larger plate by interposing heated thermoplastic material between pairs of adjacent edges of the heated plates and applying pressure to force the edges towards each other. The interposed material may be a strip of width little greater than the thickness of the plates, or a greater width may be used, to act as beam reinforcement of the filter plate assembly under the load applied by pressure or vacuum.

Similar interposition of thermoplastic strips or sheets between porous plates may be used to build up more or less elaborate assemblies, consisting either mainly of the porous sheets with the interposed material acting principally as jointing, or of a number of walls some of which are porous and others of which are of the non-porous thermoplastic material. Where the edge of a thermoplastic sheet makes sealing contact with a porous plate, the thermoplastic material may be spread into a flange to increase the area of contact. Such flanges, or the mere flash produced as previously indicated, may be subsequently subjected to heat under pressure to bring about a diffusion of thermoplastic material into an area of the porous plate substantially greater than that covered by the thickness of the thermoplastic sheet.

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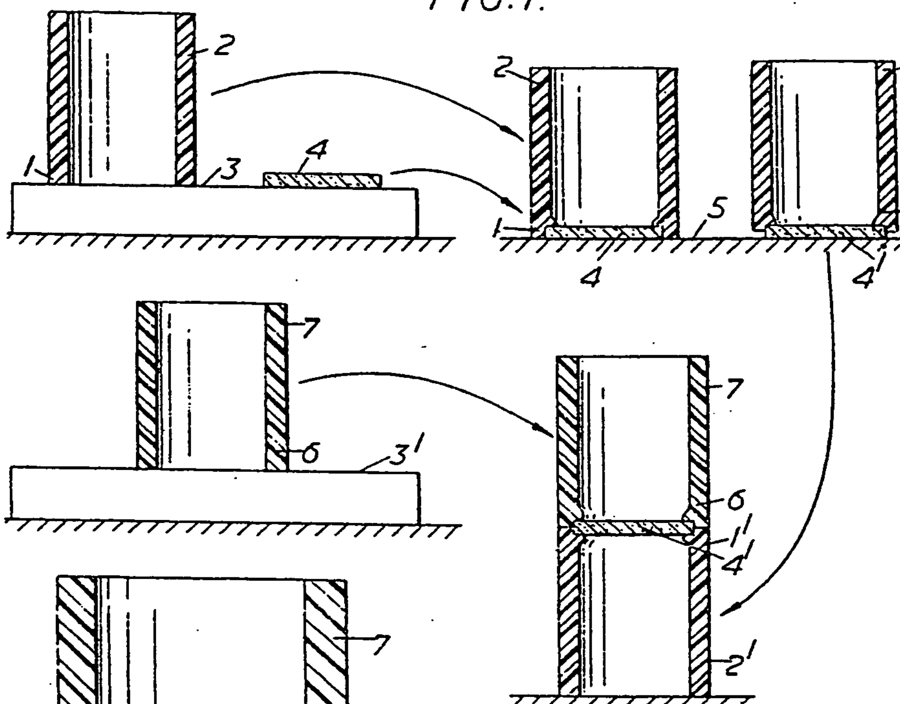
762,906 COMPLETE SPECIFICATION
3 SHEETS
This drawing is a reproduction of the Original on a reduced scale.
SHEET 1

FIG. 1.



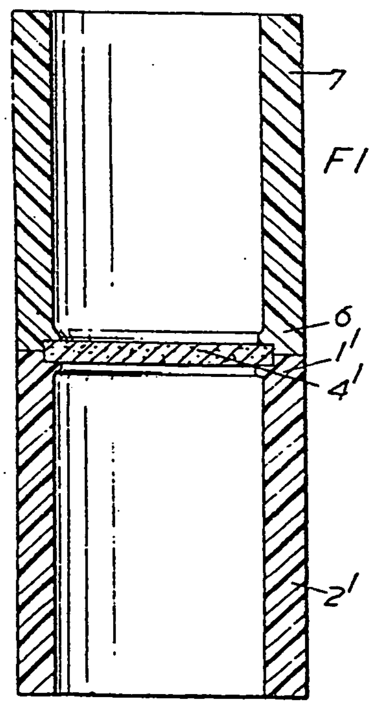


FIG. 3.

FIG. 2.

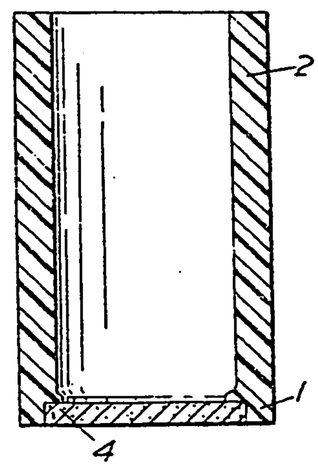


FIG. 4.

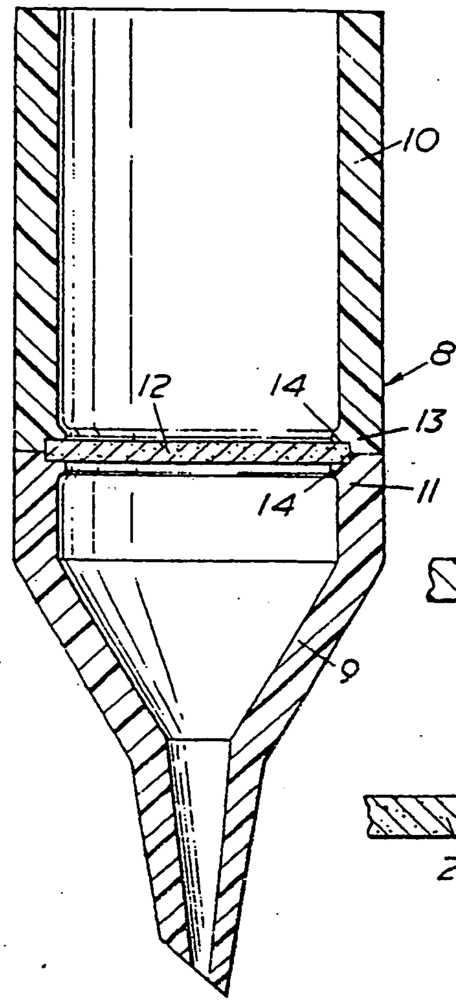


FIG. 5.

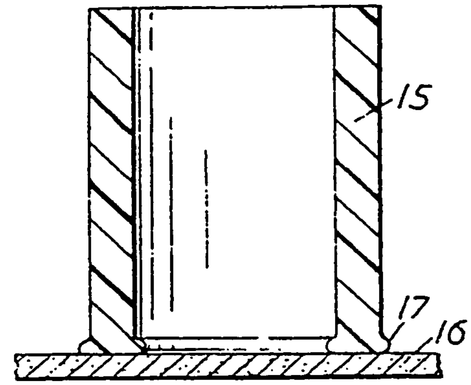


FIG. 6.

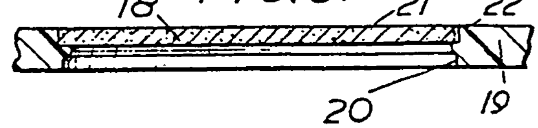


FIG. 7.

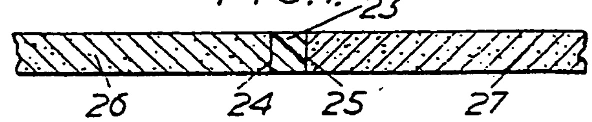


FIG. 8.

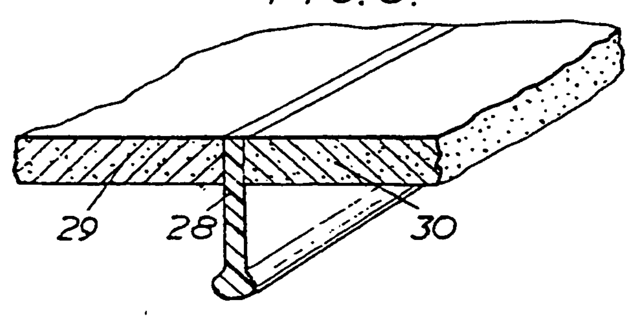
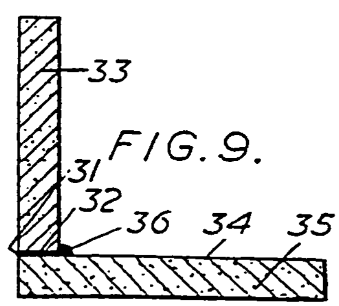


FIG. 9.



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SHEETS 2 & 3

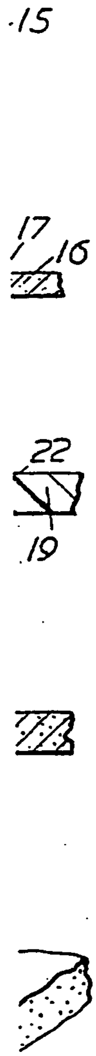

FIG. 11.

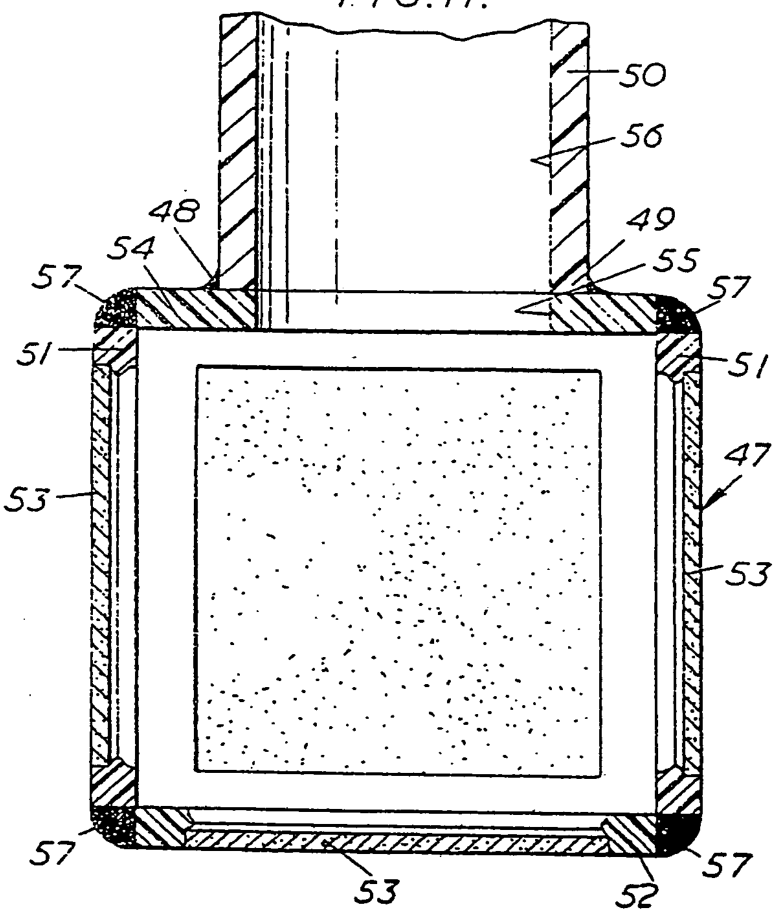

FIG. 10.

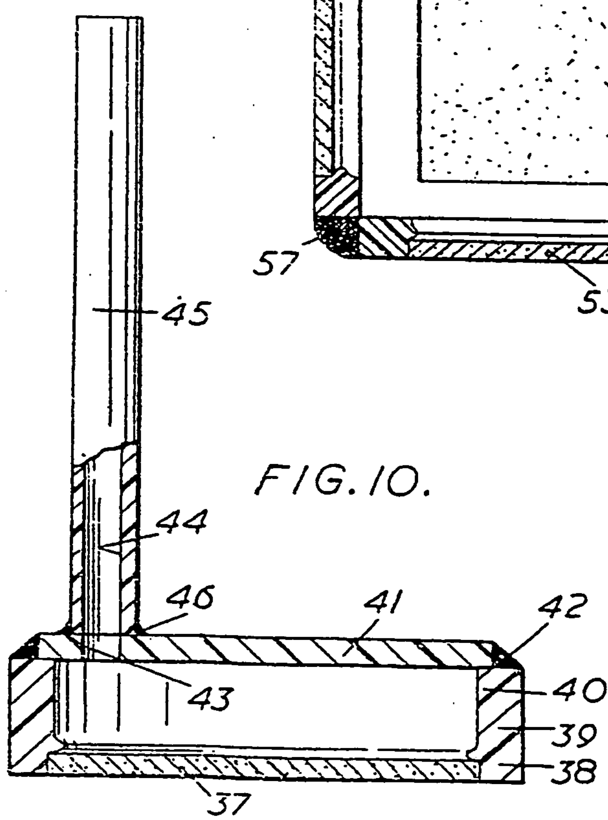

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FIG. 4.

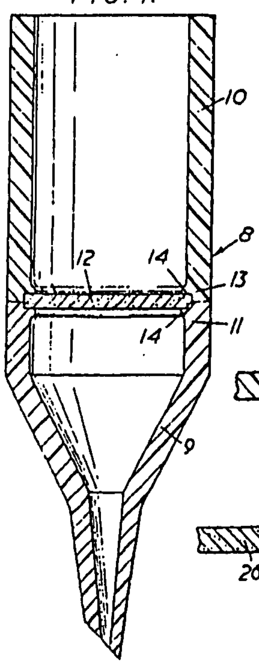


FIG. 5.

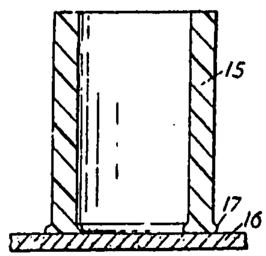


FIG. 6.

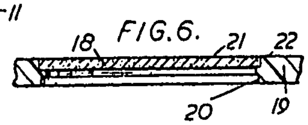


FIG. 7.

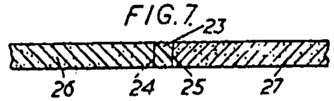
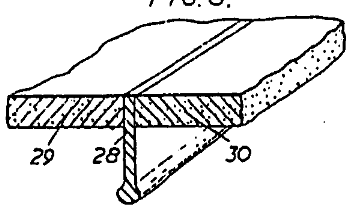


FIG. 8.



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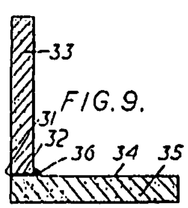

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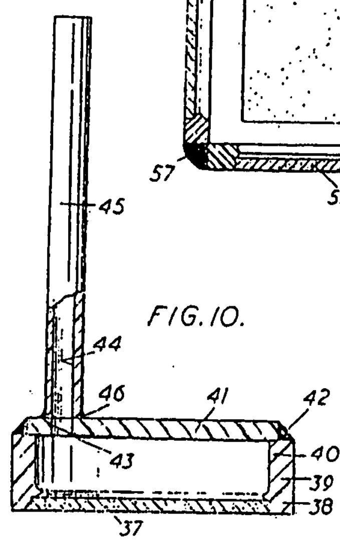

FIG. 11.